

REMARKS

In the Office Action, claims 1-5 and 11-15 stand rejected under 35 U.S.C. § 103(a) as allegedly being obvious over U.S. Patent No. 6,348,736 (McGahay) in view of U.S. Patent No. 5,610,105 (Vines). Claims 7-10 and 17-22 stand rejected under 35 U.S.C. § 103 as allegedly being obvious over McGahay in view of Vines and U.S. Patent Publication No. 2002/0090822 (Jiang). Applicants respectfully traverse the Examiner's rejections.

The invention, as set forth in independent claims 1 and 11 includes, among other things, the general features of forming a low-k dielectric layer over a substrate, heat treating the substrate to promote out-gassing of volatile materials for a predetermined period of time after forming the low-k dielectric layer, and converting an upper portion of the low-k dielectric layer into a protective dielectric to form a sacrificial cap layer after heat treating the substrate.

As admitted by the Office Action McGahay fails to teach or suggest heat treating the substrate for a predetermined period of time to promote out-gassing prior to forming the sacrificial cap layer. The Office Action relies on Vines as teaching this feature.

As the Examiner well knows, it is claimed invention, as a whole, that must be considered for purposes of determining obviousness. A mere selection of various bits and pieces of the claimed invention from various sources of prior art does not render a claimed invention obvious, unless there is a suggestion or motivation in the prior art for the claimed invention, when considered as a whole. In this case, it is respectfully submitted that the obviousness rejection is improper.

The Office Action asserts that the motivation for combining McGahay and Vines is based on the statement in the abstract that an anneal process is performed on the dielectric layer in order to minimize or eliminate volatile impurities in the dielectric layer. However, the Office

Action omits the teaching of Vines that specifically recites those impurities as being water, hydrogen, and hydrocarbon impurities. Clearly, Vines does not contemplate problems arising from nitrogen or nitrogen compounds diffusing through a low-k dielectric. Because neither McGahay nor Vines does recognizes these types of impurities or their effects, the motivation for combining the reference is lacking. The difference in the types of compounds reduced by offgassing highlights the completely different process situation and completely different process chemistry used in Vines.

Moreover, the Office Action equates the silicon dioxide layer of Vines to a low-k dielectric layer. This clearly cannot be supported. As indicated on page 3, the transition from the well-known and well-established aluminum/silicon dioxide metallization layer (taught by Vines) to a low-k dielectric/copper metallization layer (taught by Applicants) is associated with a plurality of issues, including resist poisoning due to nitrogen or nitrogen compounds. Vines clearly does not contemplate nitrogen compounds as being a potential issue. Silicon dioxide is not a low-k dielectric material, as asserted by the Office Action in paragraph 4.B. Applicants distinguish silicon dioxide from low-k dielectrics on page 3, lines 9-13. Also, it is notoriously well known in the art that silicon dioxide is considered a high-k dielectric, as compared to the groups of compounds referred to as low-k dielectrics. The mere fact that silicon dioxide contains silicon does not make it a low-k dielectric material as asserted by the Office Action. This mischaracterization of silicon dioxide further highlights the completely different process situation and chemistry employed by Vines as compared to Applicants.

There are no process or chemistry similarities between McGahay and Vines that would lead one of ordinary skill in the art to combine them in the manner suggested by the Office Action. The Office Action fails to consider the claimed subject matter taken as a whole in

attempting to combine McGahay and Vines. Due to the marked differences in process situations and chemistry, there is simply no recognition that nitrogen poisoning is an issue with low-k dielectric layers, or that such poisoning may be mitigated by heat treating a low-k dielectric layer. Accordingly, there is no motivation to combine McGahay and Vines, the combination fails to teach all the features of the claimed subject matter in that Vines teaches heat treating a silicon dioxide layer as opposed to a low-k dielectric layer, and finally, there is no reasonable expectation of success when McGahay and Vines are combined, because neither suggests heat treating a low-k dielectric layer prior to forming a cap layer.

For these reasons, the combination of McGahay and Vines fails to teach or suggest the claimed subject matter. Accordingly, claims 1, 11, and all claims depending therefrom are allowable. Applicants respectfully request the rejection of these claims be withdrawn.

Jiang fails to correct the defects identified above with respect to McGahay and Vines. Specifically, Jiang also teaches a cap layer formation step without a preceding heat treatment out-gassing step. Accordingly, the combination of McGahay, Vines, and Jiang also fails to teach or suggest the features of the claimed subject matter.

For at least the aforementioned reasons, it is respectfully submitted that all pending claims are in condition for immediate allowance. The Examiner is invited to contact the undersigned attorney at (713) 934-4070 with any questions, comments or suggestions relating to the referenced patent application.

Respectfully submitted,

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